



# **CARES Scheme for Approval of Post Tensioning Systems for Concrete Structures in Australia**

## **Appendix APT04 Quality and Operations Schedule for the Supply and Installation of Post-Tensioning Systems in Concrete Structures (excluding Highways Structures)**



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## Amendment Control Sheet

<b>Amendment summary</b>	<b>Date</b>
First issue	18.02.2021
<b>(Latest amendments highlighted throughout Appendix by an adjacent line)</b>	



## **0 INTRODUCTION**

This CARES assessment schedule relates to the quality system requirements for the supply and installation of post-tensioning systems in concrete structures in Australia, including concrete floors, slabs, walkways and containment structures but excluding highway structures, using bonded tendons in accordance with the relevant product standard and execution specification.

### **1. SCOPE**

This Schedule describes the minimum quality and operations requirements for the post-tensioning of concrete structures including concrete floors, slabs, pavements and containment structures but excluding highway structures, using bonded tendons comprising either steel strand or bars, placed within the structural member. It relates to the use of the following:

- a) ACRS approved prestressing strand or bar manufactured in accordance with AS/NZS 4672 and execution specification.
- b) Anchors for post tensioned systems which are CARES approved to CARES Appendix APT01 in accordance with AS / NZS 1314:2003 or,
- c) Comply with the performance requirements of ETAG013 6.1.1-I (Resistance to static load), 6.1.2-I (resistance to fatigue) and 6.1.3-I (Load transfer to the structure) when tested with strand which conforms to the requirements of AS/NZS 4672 or,
- d) Comply with the performance requirements of EAD160004-00-0301, sections 2.2.1, 2.2.2. and 2.2.3 respectively as detailed in an ETA when tested with strand which conforms to the requirements of AS/NZS 4672.
- e) Duct conforming with the performance requirements of CARES Appendix APT02 and the organisational and procedural requirements of AS / NZS ISO9001
- f) Prebagged grout which is CARES approved to CARES Appendix APT03
- g) The organisational and procedural requirements of AS / NZS ISO 9001.
- h) Guidance on the Post Tensioning Operation may also be found in the CARES Model Specification for Australia
- i) Further recommendations for the grouting of ducts can be found in the Concrete Institute of Australia recommended practice for Grouting of prestressing ducts.

#### **1.1 Schedule of Operations**

The organisation shall document the manufacturing and installation processes, materials, equipment, the names and grades of site operational personnel relevant to this schedule in a CARES Schedule of Operations.

Where the organisation has off-site storage facilities for PT materials and equipment other than their Head Office address these should be included in the Schedule of Operations. The Schedule of Operations shall also indicate where calibration of pumps and gauges are undertaken, whether internally or purchase this service externally, noting the provider(s).

The Schedule of Operations shall be maintained in an updated form and used by CARES in the assessment and, where appropriate, subsequent surveillance inspections.



## 2. DEFINITIONS

*Anchorage.* A mechanical device, usually consisting of several components designed to retain the force in the stressed tendon and to transmit it to the concrete.

*Anchorage zone.* The local zone in the structure through which the prestressing force is introduced into the concrete via the anchorage.

*Attendance.* The services to be provided by or through the organisation e.g. water, power, lifting equipment, access, etc.

*Bonded tendon.* A tendon bonded to the structural element by grout injection.

*Bursting reinforcement.* The reinforcement in the anchorage zone to resist transverse tensile forces due to the introduction of prestressing force.

*Client.* The body for which the works are being carried out.

*Coupler.* A device to join tendons.

*Customer.* The body engaging the organisation to carry out the work described in the contract specification according to this schedule (this would usually be the main contractor).

*Ducting.* An enclosure in which the prestressing steel is placed and which temporarily or permanently allows relative movement between the prestressing steel and the surrounding concrete.

*Execution specification.* The documents covering all drawings, technical data and requirements necessary for the execution of a particular project.

*Hold points.* Defined points in the post-tensioning installation process which require inspection or verification, by the organisation, customer or client, of the satisfactory completion of all of the necessary processes up to that point and prior to the commencement of the next stage of the process.

*Method Statement.* The document setting out the specific details, resources and sequence of activities relevant to the specific post-tensioning operation.

*Organisation.* The body responsible for the supply and installation of post-tensioning systems in accordance with the contract specification.

*Prebagged Grout.* Grout comprising a prebagged blended mixture of cement admixture and additives, mixed with water and injected into the duct to fill the space around the tendon.

*Prestressing.* The controlled generation of permanent forces and deformations in a structural concrete member to counteract the stresses arising from dead and imposed loads.

*Post-tensioning system.* An arrangement of tendons and anchorages to carry out post-tensioning.

*Quality plan.* The document or series of linked documents setting out the specific quality practices, procedures, resources and sequence of activities relevant to the project.

*Supplier.* A body approved by the organisation for the provision of specified materials, equipment or services.

*Tendon.* One or a number of prestressing steel elements, i.e. wire, strand, bar.

*Tendon-anchorage assembly.* A connection between tendon and anchorage.



### **3. OPERATION OF THE SCHEME**

The Scheme will operate as follows:

#### **3.1. Certification of the Organisation**

Certification of the organisation will be granted after a satisfactory assessment of all office and site operations relevant to on-site post tensioning activities by CARES in accordance with all parts of this Schedule, the organisation's quality plan, method statement, contract specification and AS / NZS ISO 9001.

#### **3.2. Notification of Contracts**

The organisation shall notify CARES of each site on which it has been contracted to operate. Assessments and surveillance inspections shall be carried out by CARES at selected sites to ensure satisfactory operational control against this schedule.

The organisation shall notify CARES at the beginning of each month the details of ALL SITES where they are actively installing PT using the CARES Notification of Contracts form which is detailed in Appendix

Failure to provide this information will result in a minor NCR being issued. Further failures will result in the issue of a major NCR.

### **4. QUALITY MANAGEMENT SYSTEM REQUIREMENTS**

The organisation shall operate a quality management system that complies with AS/ NZS ISO 9001 and this schedule. This Schedule interprets those elements that are particularly relevant to the installation of post-tensioning systems in concrete structures to ensure consistent product quality and continued compliance with this schedule.

#### **4.1. Documentation Requirements, Control of Records**

The organisation shall establish and maintain records to show conformity with this schedule and shall define their retention period and their disposition.

Records relating to the technical details of post-tensioning contracts shall be retained for a minimum period of 12 years and a copy of these shall, when required, be sent to the client.

Where documents and records are stored electronically, the data shall be regularly backed up to ensure no loss of data and readily retrievable with minimal loss of information in case of failure. (Also see section 9 following).

Documents and records not stored electronically shall be stored in a safe manner preventing degradation and ensuring maintenance of legibility for the period specified above.

#### **4.2. Management Responsibility**

Top management shall provide evidence of its commitment to the development and implementation of the quality management system and continually improving its effectiveness by:

- a) Communicating to the organisation the importance of meeting customer as well as statutory and regulatory requirements.
- b) Establishing the quality policy.
- c) Ensuring that quality objectives are established.



- d) Conducting management reviews.
- e) Ensuring the availability of resources.

#### **4.2.1 Quality Management System Planning**

The organisation shall produce a quality plan for each structure, contract or project as appropriate and identifying specific details on which it is contracted to operate. The quality plan shall include method statements for the relevant key post-tensioning activities e.g. duct installation, tendon installation, tendon tensioning, tendon anchorages, tendon protection and grouting. The minimum scope for a quality plan is given in section 7.

The quality plan shall identify the: human resources, responsibilities, hold points (and release authorities), processes, materials, equipment, controls, inspection, measuring and test equipment, reference standards and levels of acceptability required to meet the contract requirements.

#### **4.3. Provision of Resources**

The organisation shall identify the resource requirements in the quality plan and provide adequate resources, including materials, equipment, inspection, measuring and test equipment and trained personnel for the management, supervision and performance of the work and verification activities.

The organisation shall have a documented procedure which details the attendance required for the post-tensioning operations. The provision of attendance shall be agreed between the customer and the organisation.

##### **4.3.1. Competence, Awareness and Training**

The organisation shall:

- a) Determine the necessary competence for personnel performing work affecting product quality, including inspection and verification activities.
- b) Provide training or take other actions to satisfy these needs.
- c) Periodically evaluate the effectiveness of the actions taken, and where required certificate the trained individuals.
- d) Ensure that its personnel are aware of the relevance and importance of their activities and how they contribute to the achievement of the quality objectives.
- e) Maintain appropriate records of education, training, skills and experience.

The organisation shall ensure that all operatives are familiar with the operation of the post-tensioning equipment and post-tensioning operations. All post-tensioning operations shall be carried out by operatives with appropriate knowledge, training and proven experience in carrying out similar operations. Supervisors and operators shall be trained and certified to meet the requirements given in CARES Appendix APT05. Trainee post-tensioning personnel shall be adequately supervised when performing post-tensioning activities. Where possible all post-tensioning personnel shall carry a CARES registration card on site. At the very least a copy of their current CARES registration cards shall be held on site.

Records of installation, stressing, grouting, grout testing etc. and any intermediate records shall name all personnel involved in the activity where applicable, not just the supervisor.



#### **4.4. Purchasing**

The organisation shall have a documented procedure for purchasing materials and services from suppliers. Post Tensioning materials, where applicable, shall be purchased from CARES approved suppliers.

PT anchorage kits shall be approved to CARES PT Appendix APT01 or have a valid ETA which has been tested with strand conforming to AS/NZS 4672.

In the case of a PT kit which has an ETA, the purchasing procedure should ensure the PT manufacturer holds a valid certificate of conformity issued by an approved notified or product certification body.

Duct shall be approved to CARES PT Appendix APT02\*\*\*

Where purchased through a trader then the trader should be ACRS approved for the supply of such materials.

All materials and services shall be purchased from sources approved by the organisation. The organisation shall be responsible for the provision of post-tension system components, grout components and post-tensioning equipment. Post-tensioning stressing equipment shall comply with the requirements of the post-tensioning kit manufacturer.

\*\*\* During the launch of this Scheme then it has been agreed that this requirement will be waived until such a time that approved duct manufacturers are available.

##### **4.4.1. Purchasing Information**

The purchase orders shall include all aspects of the material or service specification, which are important in ensuring satisfactory product quality, traceability and identification.

##### **4.4.2. Evaluation of Suppliers**

The organisation shall have a documented procedure for the evaluation and selection of suppliers. Records of acceptable suppliers shall be maintained. The assessment shall account for all aspects of the service or material specification, which are important in ensuring satisfactory quality and identification of the material or service. Post-tensioning suppliers shall comply with the requirements of this schedule.

#### **4.5. Product Identification and Traceability**

The organisation shall have documented procedures that ensure product identification and traceability during all stages of production, delivery, receipt and installation into the structure and shall include the following as appropriate:

- a) The tendon source, majority heat number and coil/batch identities.
- b) The source and specification of post-tensioning anchor components (including the appropriate CARES certificate of approval or ETA certification No.)
- c) The appropriate certificate should be readily accessible with appropriate drawings available to ensure receipt of the correct PT system on site (if direct supply) or off site (if off – site storage is used by the company prior to issue to site)
- d) The source and specification of ducts and pre-bagged grout used including proof of their current CARES certification.

##### **4.5.1 The organisation shall record:**

- a) The location of the following components within the structure:
  - i. Tendon heat (cast) number and / or coil / bar batch number





- ii. PT anchor component(s) and wedge batch
  - iii. Duct batch
  - iv. Grout batch
- b) Details of the time, weather condition (Sunny, Dry, ambient temperature etc.) and structure temperatures (in the case of grouting) under which the operations were carried out
- c) Details of any interruptions to site operations.

The site records shall be included in the traceability procedure and be incorporated into the quality records.

#### **4.6. Determination of Requirements Relating to the Product**

The organisation shall ensure that all contract responsibilities and relevant design details e.g. post-tensioning system, tendon configuration, tensioning sequence, tension increments, grout, grout mixing, grout injection, grout testing, resource requirements and attendance are clearly, adequately and unambiguously defined.

The organisation shall review the requirements related to the product. This review shall be conducted prior to the organisation's commitment to supply a product to the customer and shall ensure that:

- a) Product requirements are defined.
- b) The internal and external audit reporting requirements.
- c) Contract or order requirements differing from those previously expressed are resolved.
- d) The organisation has the ability to meet the defined requirements.

Records of the results of the review and actions arising from the review shall be maintained.

##### **4.6.1 Execution Specification**

Where the organisation is responsible for the defining the product related contract requirements, they shall meet the minimum recommended requirements defined in CARES' Model Specification Australia for Post-tensioned Floors

Records of the results of the review and actions arising from the review shall be maintained.

## **5. PRODUCTION AND SERVICE PROVISION**

### **5.1. Preservation of the Product**

#### **5.1.1. Receipt**

The organisation shall have a documented procedure for the receipt of incoming material that includes inspection of material and, where appropriate, correlation of advice notes and test certificates. Inspection needs to include condition of the materials, quantities, specification and ensuring that heat/batch numbers match delivery documentation/certification.

The procedure shall incorporate the receipt of customer property.



### 5.1.2. Storage

Storage may be off site or on site but in each case the organisation shall have a prescribed procedure, which ensures that materials are stored and segregated in a manner, which prevents their corrosion, damage, deterioration and contamination.

*For clarification, unacceptable corrosion is regarded as that which cannot easily be removed by hand and permanently marks the surface of the part (such as surface pitting)*

- a) Where applicable, the organisation shall have a documented procedure for recording and identifying all materials held in stock and subsequently processed. The procedure shall ensure materials are identified to the original cast or batch information, as applicable. This system shall include material supplied by the customer.
- b) All test and inspection information shall be maintained as specified in the appropriate standard. Material shall not be released from storage until verification of conformity to specified requirements has been received.
- c) The procedure shall include all material sent to site and subsequently installed.

### 5.1.3. Handling

The organisation shall have a documented procedure for handling materials and equipment that prevents them from becoming damaged, contaminated or corroded.

### 5.1.4. Delivery

The organisation shall ensure that products are protected up to and including installation on site.

## 5.2. Control of Monitoring and Measuring Devices

The organisation shall have a documented procedure which ensures that all equipment that is used for processing, measuring and testing is identified, defined and regularly calibrated and maintained in accordance with a prescribed calibration and maintenance programme. The calibration and maintenance programme shall include any contract-specific requirements.

The calibration procedure shall comply with AS/ NZS ISO10012-1.

Measuring equipment shall be capable of measuring to the required resolution (including contract specific requirements) and shall be of a known and appropriate accuracy.

## 5.3. Internal and External Audits

The organisation shall have a documented procedure for the planning, implementing and objective reporting of internal quality audits in order to verify the effectiveness of the quality system, including site activities.

The internal audit shall include both the QMS and also site PT activities/processes and:

- a) Verify that quality activities comply with requirements specified in the organisation's quality management system.
- b) Determine the effectiveness of the quality management system.

The results of the audit shall be recorded and shall include:

- a) Objective evidence of audit findings.



- b) Recommendations for corrective actions.
- c) Verification of corrective actions.

The results of internal and external audits shall be included in the management review and shall be made available to the client where required by the execution specification.

#### **5.4. Monitoring and Measuring of Processes and Product**

The organisation shall have a documented procedure that ensures inspection and testing is conducted in accordance with the quality plan, appropriate reference standards and execution specifications.

Records of inspection and test information shall be maintained as specified by the customer and the appropriate standard or specification.

All records of installation pour watch, stressing, grouting, grout testing etc., and any intermediate records shall name all personnel involved in the activity where applicable, not just the supervisor.

Any post tensioning installation shall be traceable to the company, and individuals who carried out each stage of installation. Site installation records shall be available to detail each stage and supervisor and operatives who have undertaken the task.

The organisation shall maintain a diary record of personnel activities on each project to demonstrate adequate levels of personnel cover and appropriate levels of training and experience for each project. This record shall be made available for review during the planned office audits.

All operatives shall be under the direct control of the supervisor. A supervisor shall be present for all PT activities at each site and shall sign off all stages of the PT installation process confirming their presence and satisfactory acceptance of the work undertaken.

#### **5.5. Control of Nonconforming Product**

The organisation shall have a documented procedure for processing nonconforming work and materials, which shall include:

- a) Adequate product segregation and identification of nonconforming product.
- b) Review of nonconforming work and appropriate corrective action.

All nonconforming product shall be notified to the customer, client or supplier.

#### **5.6. Improvement**

The organisation shall continually improve the effectiveness of the quality management system through the use of the quality policy, quality objectives, audit results, analysis of data, corrective actions and management review.

Corrective action procedures shall provide for dealing with customer complaints relating to product subject to this CARES Scheme. Records of all complaints received and action taken shall be retained.



### 5.7. Corrective Action

The organisation shall have documented procedures for corrective action to eliminate the cause and potential cause of nonconformities. The procedures shall include complaints to the organisation and complaints from customers relating to the installation, workmanship and materials, which are subject to this CARES Schedule. Records of all complaints and the corrective action taken shall be maintained.

### 5.8. Technical Service

When requested by a customer or client, the organisation shall provide technical advice to customers regarding the processing and application of products and operations which are the subject of this schedule where required.

## 6. PRODUCT REQUIREMENTS

Unless otherwise specified by the client, products shall comply with the recommended requirements of CARES Model Specification Australia for Bonded Post-tensioned Floors.

### 6.1. Ducts

The organisation shall have a documented procedure for the installation of the duct system which comprises: ducts, duct connectors, grouting connections, vents, vent connections, drains, transitions to anchorages and anchorages caps.

The procedure shall ensure that:

- a) Plastic ducts comply with *fib* bulletin 75. Consideration shall be given to the exposure conditions and level of protection required when specifying the duct material.
- b) Metal ducts shall be of a minimum thickness as detailed in the CARES Model Specification Australia and be produced by a company which holds a valid certificate certified by CARES under the APT02 scheme
- c) The duct system complies with the execution specification and is produced from suitable materials and components and can resist mechanical damage during concrete placement.
- d) The duct system is correctly assembled, accurately installed and adequately fixed to resist movement and floatation during concrete placement.
- e) The position of vents shall comply with the execution specification and
- f) The ducts are kept free from standing water and contamination at all times and shall be thoroughly clean before grouting.
- g) The duct system is protected from damage during assembly and installation and concrete placement.

### 6.2 Tendon Installation

The organisation shall have a documented procedure for the installation of tendons that ensures tendons are installed safely and without degradation, contamination or damage to the tendon or the duct where applicable. The organisation shall record details of the time and weather condition (e.g. Sunny, dry, wet etc.) under which the tendon installation operations



were carried out and details of any interruptions and any problems encountered during the installation process, e.g. blockages or the use of excessive force.

The tendon shall be prestressing strand or bar used shall be obtained from firm(s) holding a valid product conformity certificate of approval supplied by the Australian Certification Authority for Reinforcing Steel (ACRS) complying with AS/NZS 4672 and shall be of a type that is compatible with the anchorage used in line with the PT kit manufacturer installation instructions.

### **6.2.1 Pour watch**

The organisation shall have a documented procedure for watching of the concrete pour and recording / rectifying of any issues which could significantly affect the original installation or disrupt subsequent installation operations. Records should be made of any rectification carried out.

### **6.2.2 Tensioning**

The organisation shall have a documented procedure for tensioning tendons which shall comply with the requirements of AS3600:2018, the PT kit manufacturer installation instructions and the execution specification. The procedure shall include the measurement and recording of tendon force and tendon extension for verification purposes.

### **6.2.3 Anchoring of Post-Tension Tendons**

The organisation shall have a documented procedure which ensures that tendons are adequately anchored and that the anchors and tendons are protected from corrosion and mechanical damage.

Anchorage components, including bursting reinforcement, shall be CARES approved to Appendix APT01 and comply with the performance requirements of AS / NZS 1314 and the execution specification. A PT kit which holds a valid ETA may also be considered as long as it meets the execution specification and there is proof of a valid certificate of conformity issued by an approved notified or product certification body.

## **6.3 Protection of Post-tensioning System Component**

The organisation shall have a documented procedure for the provision of protection of the post-tensioning system components against corrosion, contamination and mechanical damage during and after installation, prior to grouting (where applicable).

When selecting the method and type of protection, the organisation shall give due consideration to the duration and type of exposure to which the post-tensioning system components are likely to be subjected.

The maximum time period between stressing and grouting shall be 28 days. In the event this is not possible then a documented procedure shall be available to indicate the extra precautions to be put in place to prevent corrosion of the stressed tendon

## **6.4 Grout**

Where grouting is required, the organisation shall have a documented procedure for assessing the suitability of grout. Grout shall be pre-bagged and CARES approved to CARES Appendix APT01.



#### 6.4.1. Grout Suitability Testing

Prior to use and at the start of the project the organisation shall assess the grout properties in accordance with the methods specified in Appendix B, using the materials, material sources, plant and personnel proposed for use on site. Grout preparation shall be undertaken under the temperature conditions expected on site. The assessment shall be made sufficiently in advance of the grouting operations to allow controlled adjustments to the materials, procedures or equipment.

For CARES approved grout, Grout Suitability testing may be waived for a project if:

- a) the project is less than 10 tonnes of strand
- b) the organisation can prove that similar testing has been carried out for an adjacent \*\* site under their control and where the climate, water source and mixing conditions are considered the same.

*(\*\* Adjacent in this respect means a site which is not more than 10 kilometers from the original site in which Grout Suitability testing was carried out less than 3 months previous)*

#### 6.5. Grouting

The organisation shall have a documented procedure for the control of the grouting process which ensures that the grouting operation complies with the contract specification. The procedure shall include:

- a) The planning of resources, supervision, material and the attendance required, to ensure that the grouting process can be conducted without interruption.
- b) Preparation of the duct, including the expulsion of water.
- h) Grout test methods shall comply with ASTM 940 and amended requirements as detailed in Appendix B of this document and achieve the properties defined in CARES' Model Specification Australia Table 1 at the test frequency specified in table 2.
- i) Sealing of ducts and vents after grouting.

##### 6.5.1 Grouting records

At each grouting stage, the organisation shall record details of:

- a) The materials used, including batch identities
- b) Flow tests and sieve test results in accordance with Appendix A & B
- c) Providing the grout suitability test was satisfactorily carried out, a repeat of the bleed and volume test is not required on each floor or pour unless there is a change in grout supplier or a significant change in conditions (e.g. water supply or temperature).
- d) At the very minimum the bleed and volume test should be undertaken at least every 3 months as part of further grout suitability tests.
- e) Grout temperatures
- f) Location of each tendon that has been grouted.
- g) Confirmation that each tendon has been grouted.



- h) The time and weather condition (Sunny, Dry, ambient temperature etc.) and structure temperatures under which the grouting operations were carried out.
- i) Details of any interruptions and any problems encountered during the grouting process, e.g. extreme temperatures, blockages, loss of grout or loss of grout pressure.
- j) Grouting records shall be included in the quality records.
- k) Details of post grouting inspection and any remedial actions undertaken.

## **7. QUALITY PLAN**

The organisation shall produce a documented quality plan, which covers general post-tensioning operations and specific site requirements. To ensure a degree of consistency between organisations, the quality plans shall include the following:

1. The requirements of this schedule, AS / NZS ISO 9001.
2. The definition and identification of contract specific requirements and related documents including internal and external audit reporting requirements.
3. A definition of the organisational responsibilities and authorities, particularly those pertaining to verification activities.
4. The resource requirements including processes, materials and equipment.
5. The identification and status of site personnel.
6. The approval and verification requirements of purchased services and material.
7. A procedure for reviewing the work programme, adjustments to the work programme and records of programme review.
8. Procedures for office activities including communication between the office and site.
9. Method statements relating to site activities, including work instructions, quality procedures, records, inspection and test arrangements and work acceptance procedures.
10. Procedures for the control of site documentation.
11. Procedure for dealing with non-conformances.
12. Procedures to identify training needs and records to demonstrate that all personnel are adequately and appropriately trained and identified.
13. Procedures for quality audit and management review of the implementation of the quality plan.
14. The identification of hold points, the verification required, the verification responsibilities and the authority for release.
15. The selection and employment of suppliers.
16. A review of the completed contract including an analysis of defects.
17. A back up plan in case of break down / failure of tablet (if applicable – see section 9)

## **8. INSPECTION AND TEST PLAN**



## PT Appendix APT04

The organisation shall produce a documented inspection and test plan for each project. The minimum requirements of such a document should include:

- 1) The various stages of installation, referencing the control / inspection records
- 2) Responsibilities for completion of the records (Job title / position)\*\*
- 3) Responsibilities for checking of the records (Job title / position), if applicable\*\*
- 4) The identification of “hold points” where applicable at each installation stage
- 5) The identification of the responsible individuals to release to the next stage
- 6) The identification of the records necessary to allow release to the next stage
- 7) The method of release (signature, email etc)

\*\*Where any of the above are the responsibility of the frame contractor please indicate the name of the frame contractor

Such information may be provided in tabular form or in a flow diagram but shall provide sufficient clarity to ensure the requirements of this schedule are met.

Where paper documents used for recording of the installation shall be controlled with appropriate document reference numbers and version control where necessary.

All records of the installation and release signatures shall be made available for inspection on site or during office audits (in cases of completed projects) and stored appropriately in line with requirements of this schedule.

### **9. SITE DOCUMENTATION AND RECORDS - REQUIREMENTS**

Documents used for recording of the installation shall be controlled with appropriate document reference numbers and version control where necessary.

All records of the installation and release signatures shall be made available for inspection on site or during office audits (in cases of completed projects) and stored appropriately in line with requirements of this schedule.

Records of installation, stressing, grouting, grout testing etc. and any intermediate records shall name all personnel involved in the activity where applicable, not just the supervisor.

**9.1** Where tablets or electronic storage media is used, they shall:

- i) have good connectivity and adequate processing speed to allow for adequate and reasonable access to information as required by this schedule
- ii) warn when they are out of range of the internet, and be able to hold the information until it can automatically update the company “cloud” or other electronic system
- iii) be adequately charged at all times when in use
- iv) Ensure timely retrieval of information as required during the site audit

**9.2** There should be a robust back procedure to enable the continuation of recording of the site installation if the tablets or electronic storage media fail in use.





## **PT Appendix APT04**

**9.3** Failure to provide the necessary requested information or records in a timely manner during an audit may result in a minor NCR being raised. Timely retrieval of information from a secure central storage media is also acceptable



## 10 NORMATIVE REFERENCES

The following standards are relevant to the application of this scheme document.

Unless agreed otherwise during the application process, the latest version of the product or management system standards will apply. The applicable standard and date shall be stated in the CARES product and/or management system certificate published on the CARES website.

**AS / NZS ISO 9001: 2016** Quality Management Systems – Requirements.

**AS / NZS 4672.1:2007** – Steel prestressing materials Part 1: General requirements

**AS / NZS 4672.2:2007** – Steel prestressing materials Part 2: Testing requirements

**AS / NZS 1314:2003** - Prestressing Anchorages

**AS / NZS ISO10012-1: 2004:** Quality assurance requirements for measuring equipment.

**Appendix APT01** Quality and Operations Schedule for the Production and Supply of Prestressing Anchorages for Post-Tensioning Systems

**Appendix APT02** Quality and Operations Schedule for the Production and Supply of galvanised metal ducting for use in Post-Tensioning Systems

**Appendix APT03** Quality and Operations Schedule for the Production and Supply of Pre-bagged Grout Material for use in Post-Tensioning Systems

**Appendix APT05** CARES Registration Scheme for the competency of Post-Tensioning Personnel

**CARES Model Specification Australia for Bonded Post-tensioned Floors.**

**ETAG013: Edition June 2002 Amended February 2013** Guideline for European technical approval of post-tensioning kits for prestressing of structures.

**EAD 160004-00-0301:** Post-tensioning kits for prestressing of structures

**fib bulletin 75,** Polymer duct systems for internal bonded post – tensioning

**ASTM C940: 2016** Standard Test Method for Expansion and Bleeding of Freshly Mixed Grouts for Preplaced-Aggregate Concrete in the Laboratory

**ASTM C939: 2016** Standard Test Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method)

**AS 1478.2:2005** Chemical admixtures for concrete, mortar, and grout – Methods Admixtures for concrete Standards Australia.

**Concrete Institute of Australia:** Recommended Practise for Grouting of Prestressing decks (2007)





## **APPENDIX B: SITE SUITABILITY TESTING OF GROUT**

### **B1. SIEVE TEST**

**This test method is based on the requirements of ASTM C939.**

#### **Principle of test**

The test consists of pouring a quantity of grout mixed with water to the prescribed ratio through a sieve to check for the absence of lumps on the sieve. This shall only be undertaken when the grout is considered to be completely mixed prior to its intended use.

#### **Apparatus**

A 150 mm diameter sieve with an aperture of 2.4 mm.

#### **Test Procedure**

Pour a minimum of 1 litre of freshly mixed grout through the sieve.  
This may be carried out while filling the fluidity test cone as detailed in B2 below.

#### **Reporting**

Report the absence of lumps on the sieve.

### **B2. FLUIDITY (FLOW) TEST – CONE TEST METHOD.**

**This test method is based on the requirements of ASTM C939.**

#### **Principle of test**

The fluidity of grout, expressed in seconds, is measured by the time necessary for a stated quantity of grout (1.725 L) to pass through the orifice of the cone, under stated conditions.

#### **Apparatus**

The following apparatus is required for the test:

- a. The cone shall be of the design as detailed in Figure 1 of ASTM C939
- b. Stopwatch showing time to 0,1 s.
- c. Thermometer.
- d. A clean container suitable to pour uninterrupted into the test cone

#### **Test procedure**

##### **Preparation**

Mount the cone with its axis vertical and its largest diameter uppermost and support firmly in position. During the test prevent the cone from vibrating. Place the cylinder under the cone outlet. All surfaces of the cone shall be clean and shall be dampened so that the surfaces are moist but without free water. Close the lower cone orifice.

##### **Procedure**

As detailed in ASTM C939 with reporting of results as detailed below.



### **Reporting of results**

Report the time measured at  $t_0$  (after initial mix before use) and  $t_e$  (at end of use of mix, but no more than 45 minutes)

### **B3. VOLUME CHANGE / BLEED – WICK-INDUCED TEST METHOD.**

**This following test method is a modified version of ASTM C940-2016**

#### **Principle of test**

This test provides both volume change and bleeding measurements. Bleeding is measured as the volume of water remaining on the surface of the grout which has been allowed to stand protected from evaporation.

The volume change is measured as a difference in percentage of the volume of grout between the start and the end of the test. The test measures mainly the volume change caused by sedimentation or expansion.

#### **Equipment**

As detailed in ASTM C940-2016 with the addition of:

- approximately 1000 mm of the 7-wire strand which is to be / being used in the PT installation.
- a method by which to centralise the strand in the cylinder.

#### **Procedure**

Modify the test method as detailed in ASTM C940-2010 to simulate wicking of strands as follows:

Cut a 1000 mm long piece of the 7-wire prestressing strand.

Wrap the strand with 50 mm wide duct or electrical tape at each end prior to cutting to avoid splaying of the wires when it is cut.

Degrease (with acetone or hexane solvent) and wire brush to remove any surface rust on the strand before temperature conditioning.

Insert the piece of strand vertically and centrally into the grout cylinder using a centraliser and secure in position.

Introduce the grout into the graduated cylinder as per the test method.

Take readings as per the test method of ASTM C940

#### **Reporting of results**

Report the bleeding and expansion as detailed in ASTM C940-2010

### **B4. COMPRESSIVE STRENGTH**

#### **Principle of test**

This test assesses the compressive strength of the grout.

#### **Equipment**

Cube moulds used shall hold their shape and dimensions under normal conditions of use and shall be made of steel or cast iron, and of side dimension of between 50 and 75mm and be watertight to ensure no leakage of grout. All moulds shall be clean prior to use.



## **PT Appendix APT04**

A suitable container to collect grout discharged from the grout pump which will allow subsequent interrupted flow into the mould.

### **Procedure**

Cube moulds shall be placed on a firm level surface prior to pouring.

The cube samples shall only be prepared after all the adjustments to the grout mix have been made and the grout has been adequately mixed. The individual samples shall be collected from the grout pump outlet point, at between 20% and 80% of batched volume. Moulding location shall be as close as possible to point of sampling.

If necessary, the samples may be puddled to allow release of any entrapped air.

The samples must be protected from the sun, wind and rain as far as practicable.

### **Test Method**

Compression strength test in accordance with AS 1478.2 Appendix A